# Factors influencing CDM locations in China

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## Introduction

The Clean Development Mechanisms (CDM) is one of the three flexible mechanisms in Kyoto Protocol intended to lower the costs of greenhouse gas (GHG) emission reduction. Annex I parties, usually developed countries with GHG emission limits, act as the buyers at the CDM markets. They buy GHG reduction credits by supporting projects in developing countries (sellers) that will reduce emissions. The reduction when approved are called certified emission reduction (CER) credits. The project will then be called a CDM project. Buyers use CER credits to meet their reduction commitment when doing so is cheaper for them than reducing the emission directly. There are different types of CDM projects including the development of renewable energy and switching to more energy efficient production processes. The GHG reduction from the project will be monitored and certified. The CDP project cycle involves several stages, which are illustrated in Figure 1.

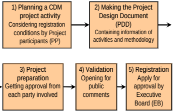


Figure 1. Stages of a project

The CDM has two purposes: 1) to help developed countries (with reduction commitments) to fulfill their quantified emission reduction targets at lower costs; 2) to support sustainable development of less developed countries through financial and technology transfer. The location of CDM projects has raised concerns that the CDM is not supporting the countries that need such transfer the most. For example, by the end of 2009, India, China, Brazil and Mexico accounted for about 80% CDM projects (Figure 2).

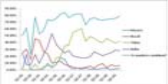

**Figure 2. World CDM projects distributions**

## CDM projects in China

While the location of CDM projects across countries is important, the location within a country can also be an indicator as to how CDM is achieving its goals. China has by far the largest share of CDM projects both in terms of the number of projects and the amount of certified carbon reduction. The objective of our study is to assess the different factors that affect the location of CDM projects within the country. Some characteristics of CDM projects in China is shown in Figures 3 and 4.

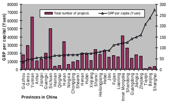


**Figure 3. GRP per capita and projects in China**

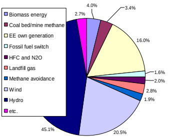


Figure 4. Percentage of the number of projects in Type

Our data covers the period from 2004 to 2009 for the 30 provinces in China except Tibet. In total, there were 2116 projects that went beyond the validation stage. Figure 3 shows a summary of Gross Regional Product (GRP) per capita and the number of projects for each province. From Figure 4, we can see that the most popular types of projects are hydro and wind power projects, accounting for about 45% and 20% of total projects, respectively. This implies natural resource endowment may be an important factor in the location of CDM projects.

## Model framework

**Panel Model**: our focus is identifying the factors that influence the amount of CDM activities in a province. The description of variables can be found in Table 1.

$$
\begin{aligned}
LN(y_{it}) = & \sum_{t=2005}^{2009} d_t * Dummy_t + \beta_1 * LN(GRP_{it-1}) + \beta_2 * LN(GRPC_{it-1}) \\
& + \beta_3 * LN(FDI_{it-1}) + \beta_4 * LN(Energy\_Indicator_{it-1}) \\
& + \beta_5 * LN(WasteGas_{it-1}) + \beta_6 * LN(Education_{it-1}) \\
& + \beta_7 * LN(Hydro\_Potential_i) + \beta_8 * LN(Wind\_Potential_i) \\
& + \beta_8 * LN(Govt\_efficiency_i) + \varepsilon_{it}
\end{aligned}
$$

$where\ y_{it} = CER_{it}\quad \text{or } y_{it} = (\text{number of projects})_{it}$

**Conditional logit model**: our interest is what affects the probability that a project will be located in a given province. Our two considerations in this model are characteristics of a province, which are the choice specific attributes, and characteristic of a project, which are the individual attributes. The choice specific variables are the same as ones we used in the previous panel model, and the project specific variable is a dummy variable whether a project is a hydro type or not.

$$P(Y_i = j) = \frac{\exp(\boldsymbol{x}_{ij}'\boldsymbol{\beta} + \boldsymbol{w}_i'\boldsymbol{\alpha}_j)}{\sum_{k=1}^{29} \exp(\boldsymbol{x}_{ik}'\boldsymbol{\beta} + \boldsymbol{w}_i'\boldsymbol{\alpha}_k)}$$

*where* $x_{ij}$ are provincial attributes for province $j$,

*where* $j = 1, 2, \ldots, 29$

$\boldsymbol{x}_{ij}$ is the choice specific (i.e. province) specific variables

$\boldsymbol{\beta}_j$ is the coefficients for the provincial variables

$\boldsymbol{w}_i$ is the individual (i.e., project) specific variables

$\boldsymbol{\alpha}_j$ is the coefficients for the project specific variables

$\boldsymbol{\alpha}_{29} = 0$, (Xinjiang province)

Table 1. Description of variables per a province (2004 -2008)

| Variable | Definition | Mean | Std Dev |
|---|---|---|---|
| CER | Certified Emission Reduction per Year | 2548.07 | 2624.46 |
| num_proj | The number of projects | 16.09 | 16.78 |
| gas_e | Emission of waste gas | 10864.28 | 8620.78 |
| GRPC | GRP per capital (yuan) | 19628.98 | 13394.07 |
| Ene_ind | Energy indicator | 1.60 | 0.80 |
| FDI | Foreign Direct Investment | 583.59 | 861.00 |
| exploit | Hydro exploitable potential | 1500.59 | 2752.46 |
| wind_potent | Wind power Potential | 3.37 | 1.67 |
| Ed_junior | Education percentage over Junior | 59.47 | 10.56 |
| Corrupt | The number of corruption cases | 3.15 | 0.99 |

## Estimation Results

As shown in Table 2, the panel model shows positive coefficients of variables are gas emission, wind potential, hydropower and FDI. Negative coefficients are GRPC and corruption cases. We did not have statistically significant effects on energy Intensity Indicator and education. In conditional logit model, the positive coefficients are gas emission, wind potential, hydropower and education. And negative coefficients are GRPC and corruption cases. We did not see statistical significance in FDI and Energy Intensity Indicator. The results on wind, Waste gas, GRP per capita are robust and the same in both models.

Table 2. Results in two models

| | **Conditional logit model** | | **Panel model (all data, y=# of project)** | |
|---|---|---|---|---|
| Parameter | Estimate | Pr > \|t\| | Estimate | Pr > \|t\| |
| ln_gas_e | 0.68 | <.0001 | 0.59 | <.0001 |
| ln_GRPC | -0.25 | 0.11 | -1.07 | 0.00 |
| ln_FDI | -0.03 | 0.67 | 0.27 | 0.03 |
| ln_exploit | -0.04 | 0.07 | 0.15 | 0.00 |
| ln_wind_potent | 0.40 | <.0001 | 0.43 | 0.01 |
| ln_Ene_ind | 0.15 | 0.32 | 0.07 | 0.78 |
| ln_ed_junior | 1.00 | 0.00 | -0.46 | 0.39 |
| ln_corrupt | -0.24 | 0.10 | -0.48 | 0.07 |
| typeH_Beijing | -14.46 | 0.97 | | |
| typeH_Hebei | -3.08 | <.0001 | | |
| … | | | | |
| typeH_Yunnan | 3.85 | <.0001 | | |
| typeH_Shaanxi | 0.82 | 0.01 | | |
| typeH_Gansu | 2.22 | <.0001 | | |
| typeH_Qinghai | 1.32 | 0.00 | | |
| typeH_Ningxia | -2.22 | 0.03 | | |

## Concluding Remarks

We examined the distribution of CDM projects across provinces in China. Overall the distribution of CDM projects is not even across the provinces. This is largely because the uneven distribution of determining factors such as natural endowment factors (hydro power and wind power potential), CO2 emission levels, and per capita income levels. Based on our estimates, it seems that the CDM helps improve environment in general in the sense that regions with relatively higher waste emissions have more projects. Our results also indicate that poor regions in China have more CDM projects, which is not inconsistent with the goal of supporting poor economies.

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